



City Of Lynchburg

Site Design Requirements

Fire Apparatus Spacing and Water Specifications

(Per 2012 International Fire Code)

If you have any questions regarding these requirements contact Battalion
Chief Thomas Goode, Fire Marshal of the City of Lynchburg

434-455-6349

Thomas.Goode@Lynchburgva.gov

IFC SECTION 503 FIRE APPARATUS ACCESS ROADS

DEFINITIONS

The following words and terms shall, for the purpose of this chapter and as used elsewhere in this code, have the meanings shown herein.

FIRE APPARATUS ACCESS ROAD. A road that provides fire apparatus access from a fire station to a facility, building or portion thereof. This is a general term inclusive of all other terms such as *fire lane*, public street, private street, parking lot lane and access roadway.

FIRE LANE. A road or other passageway developed to allow the passage of fire apparatus. A fire lane is not necessarily intended for vehicular traffic other than fire apparatus.

503.1 Where required.

Fire apparatus access roads shall be provided and maintained in accordance with [Sections 503.1.1](#) through [503.1.3](#).

Exceptions:

1. Fire apparatus access roads shall be permitted to be provided and maintained in accordance with written policy that establish fire apparatus access road requirements and such requirements shall be identified to the owner or his agent prior to the building official's approval of the building permit.
2. On construction and demolition sites fire apparatus access roads shall be permitted to be provided and maintained in accordance with Section 3310.1.

503.1.1 Buildings and facilities.

Approved fire apparatus access roads shall be provided for every facility, building or portion of a building hereafter constructed or moved into or within the jurisdiction. The fire apparatus access road shall comply with the requirements of this section and shall extend to within 150 feet (45 720 mm) of all portions of the facility and all portions of the exterior walls of the first story of the building as measured by an *approved* route around the exterior of the building or facility.

Exception: The *fire code official* is authorized to increase the dimension of 150 feet (45 720 mm) where:

1. The building is equipped throughout with an *approved automatic sprinkler system* installed in accordance with [Section 903.3.1.1](#), [903.3.1.2](#) or [903.3.1.3](#).
2. Fire apparatus access roads cannot be installed because of location on property, topography, waterways, nonnegotiable grades or other similar conditions, and an *approved* alternative means of fire protection is provided.
3. There are not more than two Group R-3 or Group U occupancies.

503.1.2 Additional access.

The *fire code official* is authorized to require more than one fire apparatus access road based on the potential for impairment of a single road by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.

503.1.3 High-piled storage.

Fire department vehicle access to buildings used for *high-piled combustible storage* shall comply with the applicable provisions of [Chapter 32](#).

503.2 Specifications.

Fire apparatus access roads shall be installed and arranged in accordance with [Sections 503.2.1](#) through [503.2.8](#).

503.2.1 Dimensions.

Fire apparatus access roads shall have an unobstructed width of not less than 20 feet (6096 mm), exclusive of shoulders, except for *approved* security gates in accordance with [Section 503.6](#), and an unobstructed vertical clearance of not less than 13 feet 6 inches (4115 mm).

503.2.2 Authority.

The *fire code official* shall have the authority to require an increase in the minimum access widths where they are inadequate for fire or rescue operations.

503.2.3 Surface.

Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be surfaced so as to provide all-weather driving capabilities.

503.2.4 Turning radius.

The required turning radius of a fire apparatus access road shall be determined by the *fire code official*.

503.2.5 Dead ends.

Dead-end fire apparatus access roads in excess of 150 feet (45 720 mm) in length shall be provided with an *approved* area for turning around fire apparatus.

503.2.6 Bridges and elevated surfaces.

Where a bridge or an elevated surface is part of a fire apparatus access road, the bridge shall be constructed and maintained in accordance with AASHTO HB-17. Bridges and elevated surfaces shall be designed for a live load sufficient to carry the imposed loads of fire apparatus. Vehicle load limits shall be posted at both entrances to bridges when required by the *fire code official*. Where elevated surfaces designed for emergency vehicle use are adjacent to surfaces which are not designed for such use, *approved* barriers, *approved* signs or both shall be installed and maintained when required by the *fire code official*.

503.2.7 Grade.

The grade of the fire apparatus access road shall be within the limits established by the *fire code official* based on the fire department's apparatus.

503.3 Marking.

Where required by the *fire code official*, *approved* signs or other *approved* notices or markings that include the words NO PARKING—FIRE LANE shall be provided for fire apparatus access roads to identify such roads or prohibit the obstruction thereof. The means by which *fire lanes* are designated shall be maintained in a clean and legible condition at all times and be replaced or repaired when necessary to provide adequate visibility.

503.4 Obstruction of fire apparatus access roads.

Fire apparatus access roads shall not be obstructed in any manner, including the parking of vehicles. The minimum widths and clearances established in Section 503.2.1 shall be maintained at all times.

503.5 Required gates or barricades.

The *fire code official* is authorized to require the installation and maintenance of gates or other *approved* barricades across fire apparatus access roads, trails or other access ways, not including public streets, alleys or highways. Electric gate operators, where provided, shall be *listed* in accordance with UL 325. Gates intended for automatic operation shall be designed, constructed and installed to comply with the requirements of ASTM F 2200.

503.5.1 Secured gates and barricades.

When required, gates and barricades shall be secured in an *approved* manner. Roads, trails and other access ways that have been closed and obstructed in the manner prescribed by Section 503.5 shall not be trespassed on or used unless authorized by the *owner* and the *fire code official*.

Exception: The restriction on use shall not apply to public officers acting within the scope of duty.

503.6 Security gates.

The installation of security gates across a fire apparatus access road shall be *approved* by the fire chief. Where security gates are installed, they shall have an *approved* means of emergency operation. The security gates and the emergency operation shall be maintained operational at all times. Electric gate operators, where provided, shall be *listed* in accordance with UL 325. Gates intended for automatic operation shall be designed, constructed and installed to comply with the requirements of ASTM F 2200.

503.7 Fire lanes for existing buildings.

The fire code official is authorized to designate public and private fire lanes as deemed necessary for the efficient and effective operation of fire apparatus. Fire lanes shall comply with Sections 503.2 through 503.6.

FIRE APPARATUS ACCESS ROADS

The provisions contained in this document are adapted from Appendix D of the International Fire Code (IFC) and is the policy used by the Lynchburg Fire Department, Bureau of Fire Prevention in applying the provisions of IFC Section 503-Fire Apparatus Access Roads.

GENERAL

D101.1 Scope.

Fire apparatus access roads shall be in accordance with this appendix and all other applicable requirements of the *International Fire Code*.

REQUIRED ACCESS

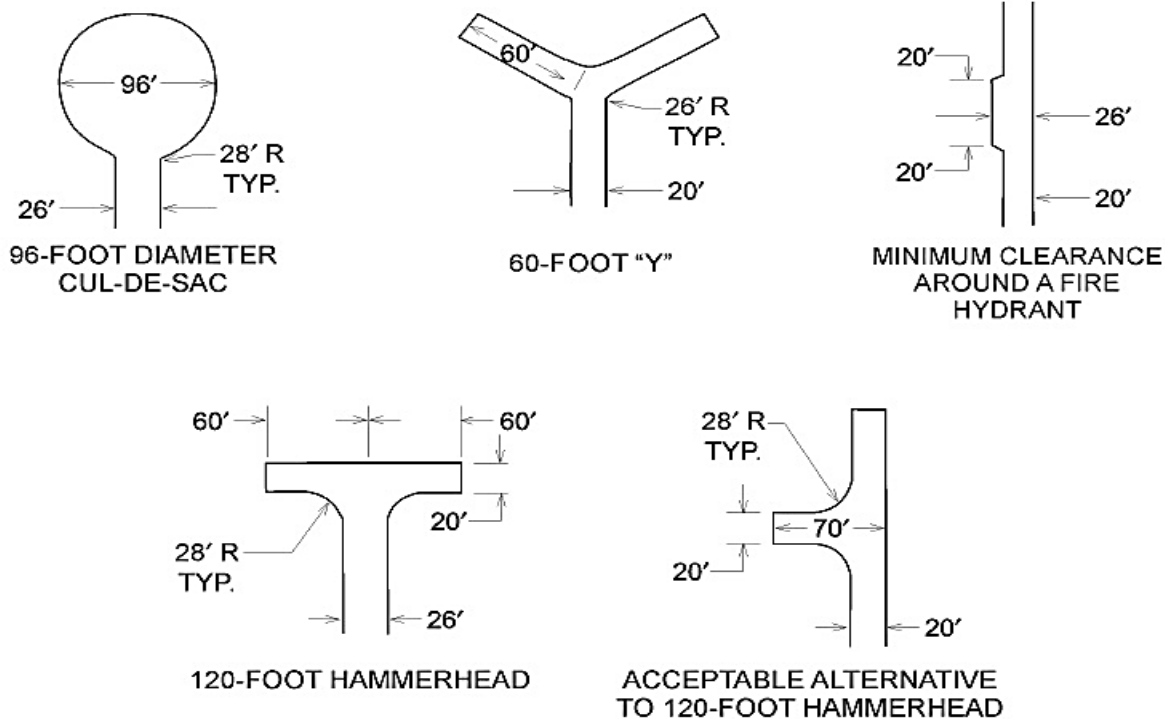
D102.1 Access and loading.

Facilities, buildings or portions of buildings hereafter constructed shall be accessible to fire department apparatus by way of an *approved* fire apparatus access road with an asphalt, concrete or other *approved* driving surface capable of supporting the imposed load of fire apparatus weighing at least 75,000 pounds (34 050 kg).

MINIMUM SPECIFICATIONS

D103.1 Access road width with a hydrant.

Where a fire hydrant is located on a fire apparatus access road, the minimum road width shall be 26 feet (7925 mm), exclusive of shoulders (see Figure D103.1).



For SI: 1 foot = 304.8 mm.

FIGURE D103.1 DEAD-END FIRE APPARATUS ACCESS ROAD TURNAROUND

D103.2 Grade.

Fire apparatus access roads shall not exceed 10 percent in grade.

Exception: Grades steeper than 10 percent as *approved* by the fire chief.

D103.3 Turning radius.

The minimum turning radius shall be determined by the *fire code official*.

D103.4 Dead ends.

Dead-end fire apparatus access roads in excess of 150 feet (45 720 mm) shall be provided with width and turnaround provisions in accordance with Table D103.4.

TABLE D103.4 REQUIREMENTS FOR DEAD-END FIRE APPARATUS ACCESS ROADS

LENGTH (feet)	WIDTH (feet)	TURNAROUNDS REQUIRED
0-150	20	None required
151-500	20	foot Hammerhead, 60-foot "Y" or 96-foot diameter cul-de-sac in accordance with Figure D103.1
501-750	26	foot Hammerhead, 60-foot "Y" or 96-foot diameter cul-de-sac in accordance with Figure D103.1
Over 750	Special approval required	

For SI: 1 foot = 304.8 mm.

D103.5 Fire apparatus access road gates.

Gates securing the fire apparatus access roads shall comply with all of the following criteria:

1. The minimum gate width shall be 20 feet (6096 mm).
2. Gates shall be of the swinging or sliding type.
3. Construction of gates shall be of materials that allow manual operation by one *person*.
4. Gate components shall be maintained in an operative condition at all times and replaced or repaired when defective.
5. Electric gates shall be equipped with a means of opening the gate by fire department personnel for emergency access. Emergency opening devices shall be *approved* by the *fire code official*.
6. Manual opening gates shall not be locked with a padlock or chain and padlock unless they are capable of being opened by means of forcible entry tools or when a key box containing the key(s) to the lock is installed at the gate location.
7. Locking device specifications shall be submitted for approval by the *fire code official*.
8. Electric gate operators, where provided, shall be *listed* in accordance with UL 325.
9. Gates intended for automatic operation shall be designed, constructed and installed to comply with the requirements of ASTM F 2200.

D103.6 Signs.

Where required by the *fire code official*, fire apparatus access roads shall be marked with permanent NO PARKING—FIRE LANE signs complying with Figure D103.6. Signs shall have a minimum dimension of 12 inches (305 mm) wide by 18 inches (457 mm) high and have red letters on a white reflective background. Signs shall be posted on one or both sides of the fire apparatus road as required by Section D103.6.1 or D103.6.2.

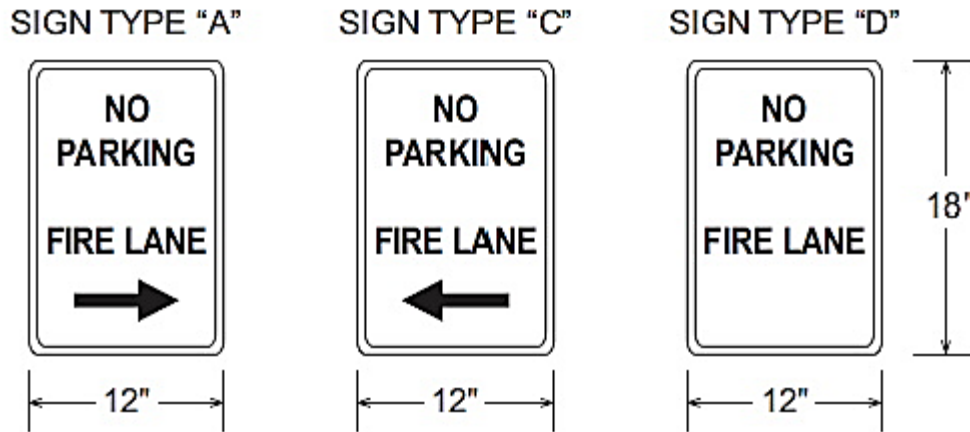


FIGURE D103.6 FIRE LANE SIGNS

D103.6.1 Roads 20 to 26 feet in width.

Fire lane signs as specified in Section D103.6 shall be posted on both sides of fire apparatus access roads that are 20 to 26 feet wide (6096 to 7925 mm).

D103.6.2 Roads more than 26 feet in width.

Fire lane signs as specified in Section D103.6 shall be posted on one side of fire apparatus access roads more than 26 feet wide (7925 mm) and less than 32 feet wide (9754 mm).

IFC SECTION 507 FIRE PROTECTION WATER SUPPLIES

507.1 Required water supply.

An *approved* water supply capable of supplying the required fire flow for fire protection shall be provided to premises upon which facilities, buildings or portions of buildings are hereafter constructed or moved into or within the jurisdiction.

507.2 Type of water supply.

A water supply shall consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.

507.2.1 Private fire service mains.

Private fire service mains and appurtenances shall be installed in accordance with NFPA 24.

507.2.2 Water tanks.

Water tanks for private fire protection shall be installed in accordance with NFPA 22.

507.3 Fire flow.

Fire flow requirements for buildings or portions of buildings and facilities shall be determined by an *approved* method.

507.4 Water supply test.

The *fire code official* shall be notified prior to the water supply test. Water supply tests shall be witnessed by the *fire code official* or *approved* documentation of the test shall be provided to the *fire code official* prior to final approval of the water supply system.

507.5 Fire hydrant systems.

Fire hydrant systems shall comply with [Sections 507.5.1](#) through [507.5.6](#).

507.5.1 Where required.

Where a portion of the facility or building hereafter constructed or moved into or within the jurisdiction is more than 400 feet (122 m) from a hydrant on a fire apparatus access road, as measured by an *approved* route around the exterior of the facility or building, on-site fire hydrants and mains shall be provided where required by the *fire code official*.

Exceptions:

1. For Group R-3 and Group U occupancies, the distance requirement shall be 600 feet (183 m).
2. For buildings equipped throughout with an *approved automatic sprinkler system* installed in accordance with [Section 903.3.1.1](#) or [903.3.1.2](#), the distance requirement shall be 600 feet (183 m).

507.5.2 Inspection, testing and maintenance.

Fire hydrant systems shall be subject to periodic tests as required by the *fire code official*. Fire hydrant systems shall be maintained in an operative condition at all times and shall be repaired where defective. Additions, repairs, *alterations* and servicing shall comply with *approved* standards.

507.5.3 Private fire service mains and water tanks.

Private fire service mains and water tanks shall be periodically inspected, tested and maintained in accordance with NFPA 25 at the following intervals:

1. **Private fire hydrants (all types):** *Inspection annually* and after each operation; flow test and *maintenance annually*.
2. Fire service main piping: Inspection of exposed, annually; flow test every 5 years.
3. Fire service main piping strainers: Inspection and maintenance after each use.

507.5.4 Obstruction.

Unobstructed access to fire hydrants shall be maintained at all times. The fire department shall not be deterred or hindered from gaining immediate access to fire protection equipment or fire hydrants.

507.5.5 Clear space around hydrants.

A 3-foot (914 mm) clear space shall be maintained around the circumference of fire hydrants, except as otherwise required or *approved*.

507.5.6 Physical protection.

Where fire hydrants are subject to impact by a motor vehicle, guard posts or other *approved* means shall comply with [Section 312](#).

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this document are adapted from Appendix B of the International Fire Code (IFC) and is used by the Lynchburg Fire Department, Bureau of Fire Protection in Applying the provisions of IFC Section 508-Fire Protection Water Supplies.

GENERAL

B101.1 Scope.

The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

B102.1 Definitions.

For the purpose of this appendix, certain terms are defined as follows:

FIRE-FLOW.

The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for firefighting.

FIRE-FLOW CALCULATION AREA.

The floor area, in square feet (m²), used to determine the required fire flow.

MODIFICATIONS

B103.1 Decreases.

The fire chief is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

B103.2 Increases.

The fire chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.

B103.3 Areas without water supply systems.

For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the *fire code official* is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code*.

FIRE-FLOW CALCULATION AREA

B104.1 General.

The fire-flow calculation area shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation.

Portions of buildings which are separated by *fire walls* without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate fire-flow calculation areas.

B104.3 Type IA and Type IB construction.

The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings.

The minimum fire-flow and flow duration requirements for one- and two-family *dwellings* having a fire-flow calculation area that does not exceed 3,600 square feet (344.5 m²) shall be 1,000 gallons per minute (3785.4 L/min) for 1 hour. Fire-flow and flow duration for *dwellings* having a fire-flow calculation area in excess of 3,600 square feet (344.5m²) shall not be less than that specified in Table B105.1.

Exception: A reduction in required fire-flow of 50 percent, as *approved*, is allowed when the building is equipped with an *approved automatic sprinkler system*.

TABLE B105.1 MINIMUM REQUIRED FIRE-FLOW AND FLOW DURATION FOR BUILDINGS

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute) ^b	FLOW DURATION (hours)
Type IA and IB ^a	Type IIA and IIIA ^a	Type IV and V-A ^a	Type IIB and IIIB ^a	Type V-B ^a		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m², 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

B105.2 Buildings other than one- and two-family dwellings.

The minimum fire-flow and flow duration for buildings other than one- and two-family *dwellings* shall be as specified in Table B105.1.

Exception: A reduction in required fire-flow of up to 75 percent, as *approved*, is allowed when the building is provided with an *approved automatic sprinkler system* installed in accordance with [Section 903.3.1.1](#) or [903.3.1.2](#). The resulting fire-flow shall not be less than 1,500 gallons per minute (5678 L/min) for the prescribed duration as specified in Table B105.1.

SECTION B106 REFERENCED STANDARDS

ICC	IBC—12	International Building Code	B104.2, Table B105.1
-----	--------	-----------------------------	----------------------------

FIRE HYDRANT LOCATIONS AND DISTRIBUTIONS

The provisions contained in this document are adapted from Appendix C of the International Fire Code (IFC) and is the policy used by the Lynchburg Fire Department, Bureau of Fire Prevention in applying the provisions of IFC Section 508-Fire Protection Water Supplies.

GENERAL

C101.1 Scope.

Fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed.

LOCATION

C102.1 Fire hydrant locations.

Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.

NUMBER OF HYDRANTS

C103.1 Fire hydrants available.

The minimum number of fire hydrants available to a building shall not be less than that listed in Table C105.1. The number of fire hydrants available to a complex or subdivision shall not be less than that determined by spacing requirements listed in Table C105.1 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted.

CONSIDERATION OF EXISTING FIRE HYDRANTS

C104.1 Existing fire hydrants.

Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

DISTRIBUTION OF FIRE HYDRANTS

C105.1 Hydrant spacing.

The average spacing between fire hydrants shall not exceed that listed in Table C105.1.

Exception: The fire chief is authorized to accept a deficiency of up to 10 percent where existing fire hydrants provide all or a portion of the required fire hydrant service.

Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in Table C105.1.

TABLE C105.1 NUMBER AND DISTRIBUTION OF FIRE HYDRANTS

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS ^{a, b, c} (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT ^d
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more ^e	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

a. Reduce by 100 feet for dead-end streets or roads.

b. Where streets are provided with median dividers which cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 7,000 gallons per minute and 400 feet for higher fire-flow requirements.

c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

d. Reduce by 50 feet for dead-end streets or roads.

e. One hydrant for each 1,000 gallons per minute or fraction thereof.

SUGGESTED FIRE FLOW CALCULATION INFORMATION

This information is provided as a suggestion only and is not required for fire flow calculations. The City of Lynchburg and the Lynchburg Fire Department are not responsible for the accuracy of this information and it should only be used as a guide to assist the user in obtaining appropriate information related to fire flow based on the Statewide Fire Prevention Code.

STATIC PRESSURE-Pressure reading before water flows.

RESIDUAL PRESSURE-Pressure reading while water is flowing (from an outlet other than the flow outlet).

PITOT PRESSURE-Reading taken by a pitot gauge inserted into the center of the flowing outlet, at a distance away from the lip of the outlet of about half the nozzle's diameter.

COEFFICIENT-Since hydrant nozzles typically don't produce perfect discharge columns, this is a correction factor which is often used to compensate for errant pitot readings. Hydrant manufacturers should be able to provide coefficients for their products. For hydrants where the coefficient is unknown, we use .95 or .90, depending upon how uniform the discharge stream looks when the hydrant is open. If a flow tube or "stream straightener" is used on the hydrant, the coefficient would be 1.

RESIDUAL BASELINE-A pressure which you determine is the lowest that a hydrant would be pulled down during actual use. NFPA states that the basis for fire flow calculations will be 20psi residual. However, in low pressure areas they allow calculations based on one-half the static pressure. Ergo, flow from a hydrant that has only 30psi static pressure can be calculated on a basis of drawing it down 15psi rather than 20psi.

OBSERVED FLOW-That is a calculation in GPM of the actual flow from one outlet flowing fully opened.

AVAILABLE FLOW-This is the calculated maximum capacity of the hydrant if it is pumped down to the basis residual pressure (usually 20psi).

Q FORMULA-The Q formula produces a value in GPM based on the nozzle diameter and pitot pressure (solving for "Q").

$$Q=29.83 cd^2vp$$

Where Q=observed flow, c=coefficient, d=outlet diameter and p=pitot pressure

HAZEN WILLIAMS FORMULA-This formula calculates available flow based on the readings taken before and during the single outlet flow test (solving for "QR").

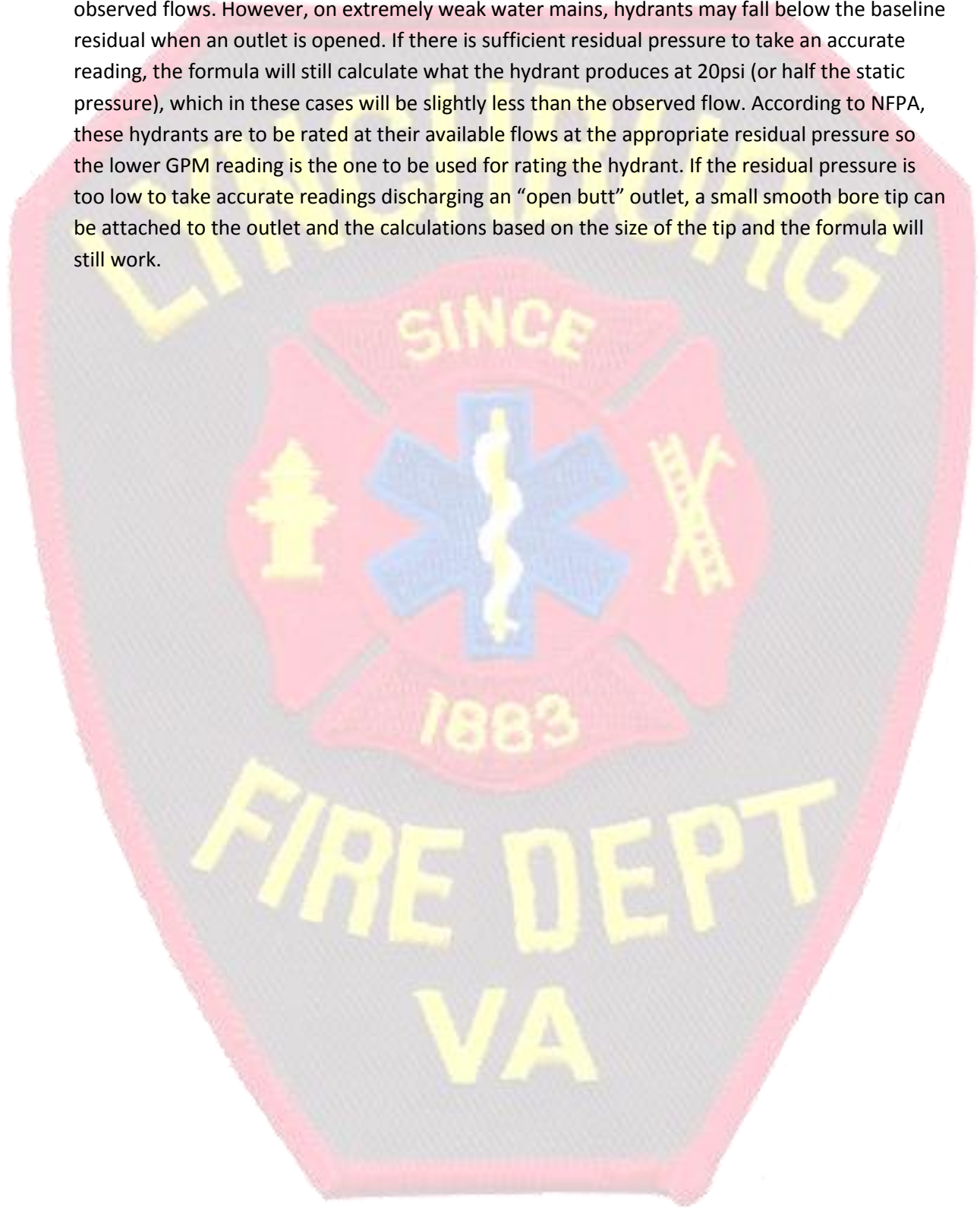
$$Q_R = Q_F \left(\frac{h_r^{0.54}}{h_f^{0.54}} \right)$$

Where QF=observed flow, "h_r" is the drop in pressure from the static pressure to the **desired** residual baseline and "h_f" is the drop in psi from static pressure to the **actual** residual pressure that was measured during the test. Please note that we are calculating to the 0.54 power (a fractional number).

We loaded these formulas into a computer program to make them practical to work. However, a programmable scientific calculator can also provide efficient results.

NOTE:

In most instances the Hazen-Williams formula will calculate available flows that are greater than observed flows. However, on extremely weak water mains, hydrants may fall below the baseline residual when an outlet is opened. If there is sufficient residual pressure to take an accurate reading, the formula will still calculate what the hydrant produces at 20psi (or half the static pressure), which in these cases will be slightly less than the observed flow. According to NFPA, these hydrants are to be rated at their available flows at the appropriate residual pressure so the lower GPM reading is the one to be used for rating the hydrant. If the residual pressure is too low to take accurate readings discharging an “open butt” outlet, a small smooth bore tip can be attached to the outlet and the calculations based on the size of the tip and the formula will still work.



NFPA Appendix C 4.10.2.1

Table 4.10.2.1 Values of h to the 0.54 Power

h	$h^{0.54}$	h	$h^{0.54}$	h	$h^{0.54}$	h	$h^{0.54}$	h	$h^{0.54}$
1	1.00	36	6.93	71	9.99	106	12.41	141	14.47
2	1.45	37	7.03	72	10.07	107	12.47	142	14.53
3	1.81	38	7.13	73	10.14	108	12.53	143	14.58
4	2.11	39	7.23	74	10.22	109	12.60	144	14.64
5	2.39	40	7.33	75	10.29	110	12.66	145	14.69
6	2.63	41	7.43	76	10.37	111	12.72	146	14.75
7	2.86	42	7.53	77	10.44	112	12.78	147	14.80
8	3.07	43	7.62	78	10.51	113	12.84	148	14.86
9	3.28	44	7.72	79	10.59	114	12.90	149	14.91
10	3.47	45	7.81	80	10.66	115	12.96	150	14.97
11	3.65	46	7.91	81	10.73	116	13.03	151	15.02
12	3.83	47	8.00	82	10.80	117	13.09	152	15.07
13	4.00	48	8.09	83	10.87	118	13.15	153	15.13
14	4.16	49	8.18	84	10.94	119	13.21	154	15.18
15	4.32	50	8.27	85	11.01	120	13.27	155	15.23
16	4.48	51	8.36	86	11.08	121	13.33	156	15.29
17	4.62	52	8.44	87	11.15	122	13.39	157	15.34
18	4.76	53	8.53	88	11.22	123	13.44	158	15.39
19	4.90	54	8.62	89	11.29	124	13.50	159	15.44
20	5.04	55	8.71	90	11.36	125	13.56	160	15.50
21	5.18	56	8.79	91	11.43	126	13.62	161	15.55
22	5.31	57	8.88	92	11.49	127	13.68	162	15.60
23	5.44	58	8.96	93	11.56	128	13.74	163	15.65
24	5.56	59	9.04	94	11.63	129	13.80	164	15.70
25	5.69	60	9.12	95	11.69	130	13.85	165	15.76
26	5.81	61	9.21	96	11.76	131	13.91	166	15.81
27	5.93	62	9.29	97	11.83	132	13.97	167	15.86
28	6.05	63	9.37	98	11.89	133	14.02	168	15.91
29	6.16	64	9.45	99	11.96	134	14.08	169	15.96
30	6.28	65	9.53	100	12.02	135	14.14	170	16.01
31	6.39	66	9.61	101	12.09	136	14.19	171	16.06
32	6.50	67	9.69	102	12.15	137	14.25	172	16.11
33	6.61	68	9.76	103	12.22	138	14.31	173	16.16
34	6.71	69	9.84	104	12.28	139	14.36	174	16.21
35	6.82	70	9.92	105	12.34	140	14.42	175	16.26

4.10.2.2 Knowing the values of h_1 and h_2 and QF , the values of $h_1^{0.54}$ and $h_2^{0.54}$ can be read from the table and Equation 4.10.1.2 solved for QR'

4.10.2.3 Results are usually carried to the nearest 100 gpm (380 L/min) for discharges of 1000 gpm (3800 L/min) or more, and to the nearest 50 gpm (190 L/min) for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations.

4.10.2.4 Insert in Equation 4.10.1.2 the values of $h_1^{0.54}$ and $h_2^{0.54}$ determined from the table and the value of QF , and solve the equation for QR'

Hydrant Flow Test Report

Location _____ Date _____

Test made by _____ Time _____

Representative of _____

Witness _____

State purpose of test _____

Consumption rate during test _____

If pumps affect test, indicate pumps operating _____

Flow hydrants: _____ A_1 _____ A_2 _____ A_3 _____ A_4 _____

Size nozzle _____

Pitot reading _____

Discharge coefficient _____ Total GPM _____

GPM _____

Static B _____ psi Residual B _____ psi

Projected results @20 psi Residual _____ gpm; or @ _____ psi Residual _____ gpm

Remarks _____

Location map: Show line sizes and distance to next cross-connected line. Show valves and hydrant branch size. Indicate north. Show flowing hydrants – Label A_1 , A_2 , A_3 , A_4 . Show location of static and residual – Label B.

Indicate B Hydrant _____ Sprinkler _____ Other (identify) _____